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Redescription of *Crematogaster subnuda subnuda* Mayr, 1879 (Hymenoptera : Formicidae : Myrmicinae)

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Abstract

***Crematogaster subnuda subnuda* is redescribed in detail on the basis of major and minor workers, female and male castes are described for the first time. This adds to much needed information regarding this species.**

Crematogaster subnuda subnuda Mayr 1879 was originally described on the basis of worker caste from India. Later on FOREL (1902) described several infraspecific taxa (*C. subnuda* r. *politula, C. subnuda* r. *politula* var. *ruginota, C. subnuda* r. *rabula* , *C. subnuda* r. *rabula* var. *nilgirica, C. subnuda* r. *rabula* var. *nicevillei, C. subnuda* r. *contemta, C. subnuda* r. *contemta var. notabilis,*) of *C. subnuda.* Bingham (1903) listed *C. subnuda* from India, Burma (Myanmar) and Srilanka. But Emery (1922), Santschi (1925) and Wheeler (1930) treated *C. subnuda* as subspecies of *Crematogaster brunnea* Smith, 1857. Santschi (1928) and earlier Wheeler (1929) had placed *subnuda* as subspecies of *Crematogaster laboriosa* Smith, 1874. While studying collection of Indian Museum, Calcutta, Mukerjee (1930) raised *subnuda* again to species level on the basis of two workers. Karyotype analysis of *subnuda* was provided by Imai *et al.* (1984). *Crematogaster subnuda* have also been reported from India by Tiwari, 1999 and Bharti, 2001. Although two current allopatric subspecies, *C. subnuda discinodis* Emery, 1893 (Singapore) and *C. subnuda formosae* Wheeler, 1909 (Taiwan) are accepted (Bolton 1995 and Bolton *et al.,* 2007). But till to date no complete taxonomic description complying with modern taxonomic parameters is available. For the first time, a comprehensive description of *C. subnuda subnuda* major and minor workers is given, including the description of gynes and males. Figures of male genitalia, of other morphological characters and notes on ecology are provided in this paper; with a view that it will help in the further understanding of this taxonomically difficult genus.

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MATERIALS AND METHODS

For collection of material variety of habitats were explored i.e. soil, leaf litter, tree bark etc. Samples were stored in 70% ethanol. Specimens were mounted on dry pin. Figures for the present text have been drawn with ocular grid fitted in stereo zoom trinocular microscope. Explanation of measurements and indices are as follows:

TL: Total measurable length of body in profile.

Head length: Length of head measured from mid point of anterior margin of clypeus to the mid point of occipital border.

Head width: In worker and queen, the maximum width of head observed in full face view excluding the eyes. In male, maximum width of head including eyes.

Scape length: Maximum measurable length of scape excluding basal most condyle or neck.

Scape index: Scape length / head width.

Eye diameter: Maximum width of eye measured at a right angle to the longitudinal axis.

Pronotal width: Maximum width of pronotum measured from directly above and at right angle to the long axis of the alitrunk.

Alitrunk length: Maximum distance from the base of anterior slope of pronotum (excluding cervix) to the anterior margin of propodeal declivity (or beginning of declivity).

Propodeal spine length: Length of propodeal spine from base to apex in lateral view.

Propodeal spine width: Maximum basal width in dorsal view.

Petiole length: Maximum length of petiole from its joining with propodeum and between post-petiole in dorsal view.

Petiole width: Maximum width of petiole in dorsal view.

Post-petiole length: Maximum length of post-petiole from its joining with petiole and between gaster in dorsal view.

Post-petiole width: Maximum width of post petiole in dorsal view.

DEPOSITORIES:

FRI – Forest Research Institute, Dehradun, India

NHM – Natural History Museum, London

PCB – Personal Collections, Bharti

PUP – Punjabi University, Patiala, India

MATERIAL EXAMINED

a) Material examined at Natural History Museum, London includes: Syntype of *C. rabula* bearing labels, ' C. rabula, Forel, Poonir XXVI, (Wroughton)'; Syntype of *C.brunnea* bearing label 'SAR'; § (female) of *C. subnuda* with labels, "Donisthorpe, B.M. 1934-4"; Minor worker of *C. subnuda* with labels, "F. Smith, 79-22, Calcutta" ; 2 workers of *C. subnuda var. rabula* by Bingham (205) 1902-120 and 3 workers by Bingham (206); Worker of *C. subnuda* bearing labels, " Dohnavur, Tinnevelly, 350, S. India, 30.IX.38 (B.M. – C.M. expedition to S. India, Sept.- Oct. 1938)" ; 3 workers of *C. subnuda* det. Donisthorpe bearing labels, " Kumaon, Almora, India, H.G.C."; 3 workers *C. subnuda* bearing labels , " Bandra, India, Dr. Jayakar, 1905-152, det. Donisthorpe"; *C. brunnea ssp. subnuda* with labels as 'Donisthorpe, 12.X.1932, Kanha,Banjar,Mandala, C.P., B.M. Bhatia, 18.II.1927 (one worker of 23.I.1927 and other of 6.II.1927 with same data).

b) Other material examined: 3 major workers, 5 minor workers bearing labels, F.R.I. Insect Survey, New Forest, Dehradun, 5.8.1930" det. Mukerjee (FRI, Dehradun); India: Punjab, Patiala, 250m, 13-15.VI.1999, leg. H. Bharti, 100 major workers, 20 minor workers, 35 § (females), 5 $ (males) (PCB, PUP); India: Punjab, Ropar, 300m, 6.III.2000, leg. H. Bharti, 5 minor workers (PCB, PUP); India: Himachal Pradesh, Paunta Sahib, 340m, 10.V.2001, leg. H. Bharti, 6 major workers (PCB, PUP); India, Haryana, Morni Hills, 1130m, 20.III. 2001, leg. H. Bharti, 8 major workers (PCB, PUP); India: Punjab, Kiratpur Sahib, 300m, 2.IV. 2002, leg. H. Bharti, 2 major workers (PCB, PUP); India, Haryana, Ambala, 230m, 10.VI.2002, leg. H. Bharti, 4 major workers (PCB, PUP); India, Uttaranchal, Dehradun, 660m, 17.VI.2002, leg. H. Bharti, 10 major workers (PCB, PUP); India, Himachal Pradesh, Terrace, 412m, 12.IX.2003,leg. H. Bharti, 17 major workers (PCB, PUP); India, Punjab, Malakpur nr.Pathankot, 400m, 17.IV.2003, leg. H. Bharti, 9 major workers (PCB, PUP); India, Himachal Pradesh, Rewalsar, 1330m, 18.VI.2003, leg. H. Bharti, 10 major workers, 12 minor workers (PCB, PUP); India, Punjab, Talwara, 280m, 13.VIII.2004, leg. H. Bharti, 9 major workers (PCB, PUP); India, Himachal Pradesh, Solan, 1350m, 26.V.2005, leg. H. Bharti, 22 major workers (PCB, PUP); India, Himachal Pradesh, Kullu, 1219m, 16.VI.2005, leg. H. Bharti, 30 major workers, 8 § (females), 4 $ (males) (PCB, PUP); India, Himachal Pradesh, Terrace, 390m, 11.V.2006, leg. H. Bharti, 10 major workers, 2 § (females), 2 $ (males) (PCB, PUP).

REDESCRIPTION

***Crematogaster subnuda subnuda* Mayr, 1879**

Crematogaster subnuda Mayr, 1879: 680

Crematogaster (Acrocoelia) brunnea ssp. *subnuda*: Emery 1922: 150

Crematogaster brunnea ssp. *subnuda*: Santschi 1925: 85

Crematogaster laboriosa ssp. *subnuda*: Santschi 1928: 33

Crematogaster subnuda: Mukerjee 1930: 153 [revived from synonymy]

WORKERS

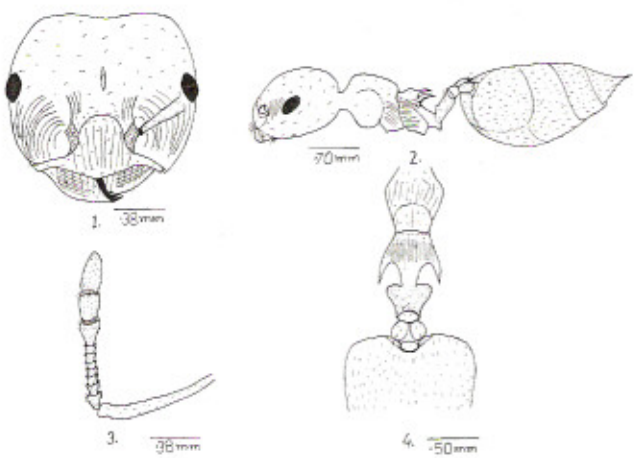
(Major) (Figs. 1-4)

Length : 5.2 mm; Head length : 1 mm; Head width : 96-1 mm; Scape length : 0.83-0.85 mm; Scape index : 85.7; Eye diameter : 0.16 mm; Pronotal width : 0.66 mm; Alitrunk length : 1.23-1.25 mm; Propodeal spine length : 0.16 – 0.18 mm; Propodeal spinal width : 0.63 mm; Petiole length : 0.43 mm; Petiole width : 0.46 mm; Post-petiole length : 0.33

mm; Post-petiole width : 0.33 mm; Cephalic index : 98.

Head (Figs. 1-3): As long as broad, sides convex, occipital margin not straight; mandibles with five teeth (apical two largest, third smaller, fourth reduced in some followed by fifth basal tooth); palp formula 5, 3; clypeus slightly convex, posterior margin extending beyond antennal bases; frontal carinae indistinct, diverging posteriorly, a faint groove like line between carinae; antennal scrobes absent; antennae 11 jointed, club formed by three apical segments, last segment much longer than preceding two, joint three to five of flagellum almost as long as broad, remaining distinctly longer than broad; scape slender, narrow at base widening towards apex, just extending beyond the upper margin of head; eyes large, lateral, placed slight above mid-line of head; longitudinal striae at anterior margin of head below eyes (at gena), striae converging towards frontal carinae, few striae on frontal area along frontal carinae; clypeus and mandibles also longitudinally striate; rest of head subopaque, smooth; anterior clypeal lateral margin fringed with setae; flagellar joints one to nine with oblique short hair; apical three pubescent; a few semi erect hairs on underside of head.

Alitrunk, Petiole and Post-Petiole (Figs. 2, 4): Pronotal dorsum flat, rounded anteriorly with lateral angles prominent seen in frontal view; pro-mesonotal suture faintly indicated; mesonotum wide anteriorly, narrowing posteriorly, slightly depressed towards meso-metanotal suture, a feeble longitudinal carina in middle of mesonotum; metanotal groove wide and shallow, well distinct in profile; propodeum below the level of pro-mesonotum in profile, its dorsum narrow anteriorly, its lateral margins continuing to form outer margin of divergent propodeal spines (metanotal spines), inner margin of spines continuing with lateral margin of propodeal declivity, propodeum dorsum subequal with declivity in profile; propodeal spines thick at base straight and acute, divergent when seen from dorsum; petiole widening anteriorly with obtuse elevated lateral angles, portion between obtuse angles depressed, posteriorly narrowing with depressed transverse portion encircling apical tubercle; sub-petiolar process in the form of minute triangular denticle; post-petiole with two anterior tubercles, furrow separating them widening posteriorly, and with transverse rounded tubercle at apex; pronotum dorsum with wide longitudinal striations interspersed with fine irregular punctures; mesonotum dorsum without striations, but with longitudinally striate on sides; propodeum dorsum more regularly and finely striate as compared to pronotum, its sides striated like mesonotum, propodeal declivity smooth and shinning; petiole and post-petiole finely punctured; alitrunk not pilose except legs with few scattered short oblique hairs; petiole with two setae (bordering anterior margin of its tubercle) slightly slanting posteriorly; post-petiolar tubercles, each with seta (on posterior margin) but more slanting as compared to petiolar setae.



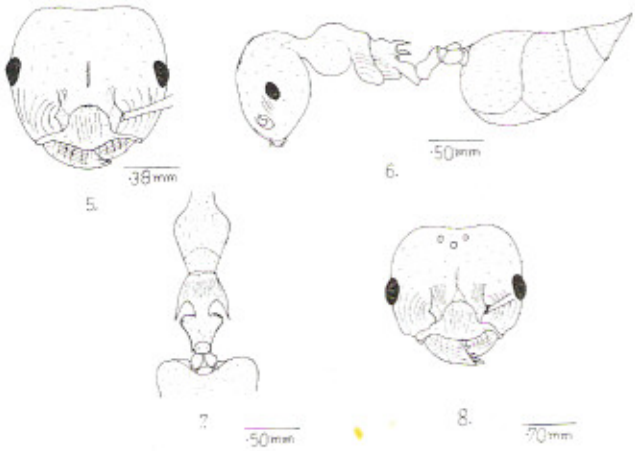
Figs. 1-4. (Major workers)
(1) Head, frontal view (scale bar 0.38 mm); (2) Head, alitrunk, petiole, post-petiole and gaster in dorsolateral view (scale bar 0.70 mm); (3) Antenna (scale bar 0.38 mm); (4) Alitrunk, dorsal view (scale bar 0.50 mm)

Gaster (Fig. 2): Gaster massive, cordate and elongate; basal tergite punctured anteriorly; covered with wide recumbent short hairs, few long oblique hairs on under underside of gaster, sting exerted.

Head, alitrunk, petiole and post-petiole dark reddish brown except scape, apical segment of flagellum, which are a shade darker; gaster very dark brown almost black with apical margins of tergites pale.

(Minor) (Figs. 5-7)

Length : 3.6-4 mm; Head length : 0.83-0.86 mm; Head width : 0.76-0.86 mm; Scape length : 0.69-0.70 mm; Scape index : 85.8; Eye diameter : 0.16 mm; Pronotal width : 0.50-0.51 mm; Alitrunk length : 1.16-1.20 mm; Propodeal spine length : 0.15-0.17 mm; Propodeal spines width : 0.50 mm; Petiole length : 0.33 mm; Petiole width : 0.33 mm; Post-petiole length : 0.20 mm; Post-petiole width : 0.20

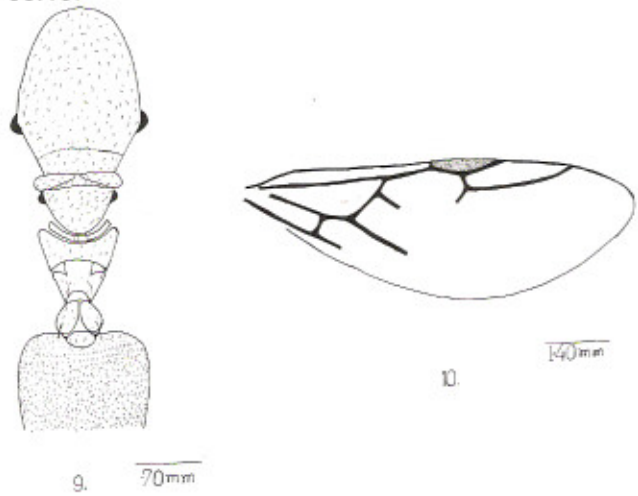


Figs. 5-7. (Minor worker)
(5) Head, frontal view (scale bar 0.38 mm); (6) Head, alitrunk, petiole, post-petiole and gaster in dorsolateral view (scale bar 0.50 mm); (7) Alitrunk, dorsal view (scale bar 0.50 mm)

mm; Cephalic index : 95.85. Similar to major except striations on head faintly indicated; mesonotum not carinate.

Gynes (Figs. 8-10)

Length : 9.0-9.26 mm; Head length : 1.36-1.48 mm; Head width : 1.36-1.38 mm; Scape length : 0.93-0.95 mm; Scape index : 68.6; Eye diameter : 0.26 mm; Pronotal width : 1.16-1.20 mm; Alitrunk length : 2.44-2.66 mm; Petiole length : 0.33 mm; Petiole width : 0.63 mm; Post-petiole length : 0.46 mm; Post-petiole width : 0.56 mm; Cephalic index : 66.19.



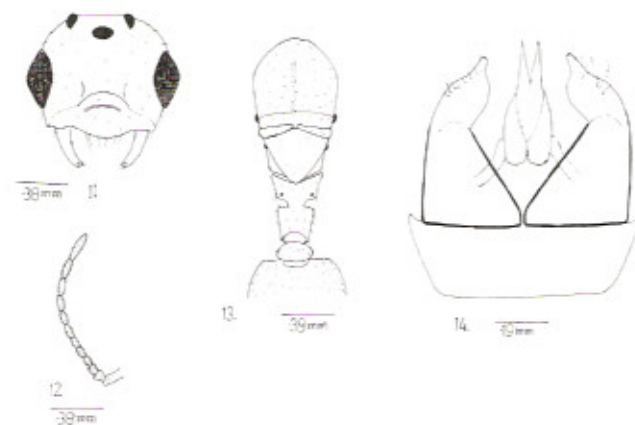
Figs. 8-10 (Female)
(8) Forehead, frontal view (scale bar 0.70 mm); (9) Alitrunk, dorsal view (scale bar 0.70 mm); (10) Forewing (scale bar 1.40 mm)

Head like major worker but with prominent ocelli; anterior clypeal margin not so convex as in worker; pronotum dorsum suboval in profile; mesonotum small narrower in middle; metanotum semicircular; propodeal spines reduced to small denticles; alitrunk smooth and shinning; petiole and post-petiole like major worker; abdomen long and massive; whole of insect more pilose as compared to major worker; fore-wing with one Radial cell, one incomplete cubital and discoidal cell.

Males (Figs. 11, 14)

Length : 4.5-4.6 mm; Head length : 0.53-0.56 mm; Head width (including eyes) : 0.66-0.68 mm; Scape length : 0.13 mm; Scape index : 19.40; Eye diameter : 0.23 mm; pronotal width : 0.90-1 mm; Alitrunk length : 1.70-1.75 mm; Petiole length : 0.33 mm; Petiole width : 0.33 mm; Post-petiole length : 0.16 mm; Post-petiole width: 0.33 mm; Cephalic index : 124.07.

Head small with occipit transverse sides, convex towards eyes; ocelli prominent; eyes large; mandibles small, elongate with two minute denticles; anterior clypeal margin slightly rounded, with a semicircular furrow in middle; frontal carinae indistinct, wide apart; antennae 12 jointed, filiform, apical joint longest, scape and basal two joints of flagellum almost equal; alitrunk like female except pronotum dorsum which is longitudinally furrowed in middle along entire length; petiole wide narrowing posteriorly with obtuse angles, as in Fig. 13; post-petiole without longitudinal furrow; shining dark brown except flagellum, legs, petiole



Figs. 11-14. (Male)
(11) Forehead, frontal view (scale bar 0.38 mm); (12) Antenna (scale bar 0.38 mm); (13) Alitrunk, dorsal view (scale bar 0.38 mm); (14) Genitalia (scale bar 0.19 mm)

which are pale; pilosity recumbent of long golden hair; flagellum of antennae densely pubescent; fore-wing like that of female with one radial (=marginal) cell, incomplete cubital and discoidal cell. Genitalia as in Figure 14.

Immature Stages

Some of the immature stages were also collected along with adult castes. Following observations have been made in these:

1. Length of larva: 3.33 mm to 5.33 mm.
2. Length of worker pupa: 3.83 mm, probably in advanced stage of development with mandible dentition clear (3 apical large teeth followed by two minute denticles); antennae passing laterally on either side of mandibles; all other structures well developed like major; pale yellow in colour.
3. Three stages of female pupae were collected; in least developed stage: length : 6.83 mm; eyes, antennae, legs developed; antennae passing laterally on either side above the base of mandible; alitrunk similar to adult female in development except mesonotum not furrowed in middle; petiole, post-petiole rectangular; post-petiole with out any indication of longitudinal furrow; gaster like adult female; petiole, post-petiole, gaster with transverse striations running along entire dorsum; fore-wing with one complete radial (=marginal) cell, complete cubital (=submarginal) and discoidal cells, unlike of adult female where cubital and discoidal are incomplete; colour pale yellow. Second stage of female pupa (length : 6.90 mm) with ocelli; mandible teeth; furrow in post-petiole; colour pale yellowish brown, eye-colour brown, rest like first stage. Most advanced stage of female pupa in collected material same in length, but mandibles with 5 teeth; petiole, post-petiole like adult female; eyes and ocelli more brown as compared to second stage.

Intraspecific variation

In some specimens 4th tooth of mandible is reduced; propodeal spines slightly shorter, apart from colour of body which is dark brown all over. And with pubescence more pronounced on head, alitrunk and gaster.

Distribution

India.

Differential diagnoses: *Crematogaster subnuda subnuda* has been related to *Crematogaster brunnea* by various workers (discussed in introduction), but can be easily separated as a distinct species; head more globose in *brunnea*; propodeal spines straight in line with propodeum dorsum in *subnuda subnuda* (in profile), but elevated at 25° and more divergent in *brunnea;* petiole anteriorly straight or slightly angular in *brunnea*, but widened with lateral angles obtuse in *subnuda subnuda*; mandibles with five teeth in *subnuda subnuda*, four in *brunnea*; clypeus bent inwards towards its anterior margin in *brunnea*, not so in *subnuda subnuda*.

Ecology: *Crematogaster subnuda subnuda* nests in bark or wood of trees. Most of the foraging workers have been collected from trees (*Acacia, Guava, Morus alba* (Mulberry), *Pinus* etc.). Species prefers to build nests in bark or dead/decaying wood. The total area occupied by nest on an average is about two to three feet long, and three to four cms. deep, spreading in the form of interconnected galleries. Workers have been noticed tending lycaenid larvae, bugs and in one instance tending dipteran larvae (feeding on carcass). The altitudinal range of *Crematogaster subnuda subnuda* (recorded during present studies) goes up to about 1638m above mean sea level in the Himalayan belt; beyond this range it is gradually dominated by other species like *C. rogenhoferi*. Probably *C. subnuda subnuda* is more adapted to warm climate and increase in altitude has a marked effect on its distribution.

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Appendix

Data of *Crematogaster brunnea* subsps. *rabula* Forel examined for comparison :

1. 10 workers bearing labels, Fraserpet, Coorg. F.R.I. Sandal Insect Survey, 8.III.1930" det. Mukerjee (FRI, Dehradun).
2. 8 workers India, 'Himachal Pradesh, Dunera, 700m, 10 May 2000', H. Bharti (PCB, PUP).
3. 4 workers, India, 'Punjab, Ropar, 300m, 8 June, 2001', H. Bharti (PCB, PUP).
4. 7 workers, India, 'Haryana, on way to Morni Hills, 740m, 20 March, 2001', H. Bharti (PCB, PUP).
5. 5 workers, India, 'Punjab, Nangal, 340m, 4 April, 2002', H. Bharti (PCB, PUP).
6. 12 workers, India, 'Karnatka, Mysore, 740m, 5 March, 2002', H. Bharti (PCB, PUP).
7. 7 workers, India, 'Panji, Goa, 740m, 25March, 2003', H. Bharti (PCB, PUP).

Personal codes of Bharti for *C. subnuda* (A-84, 143, A-15, 93, 94, 244, 294, 295); *C. brunnea sub. rabula* (12, 13, 22, 232, 245, 246).

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